1,046,297

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,046,297

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Int. Cl.:—B 23 k//B 23 j, 1

COMPLETE SPECIFICATION

Straightening Machine

I, GEORGE A. E. COUTURE, of 1180, Murray Avenue, Quebec 6, P.Q., Canada, a Canadian Citizen, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a machine for bending articles into the desired shape and more particularly comprises a new and improved machine for automatically straightening tempered items such as blades, spring leaves and shafts which become distorted in an irregular fashion when heat treated. At the present time, distortions in those items are corrected manually. Each item is individually inspected and when found to be distorted in any way, a time consuming hand operation is employed to correct the irregularities found.

One important object of this invention is to obviate the need for manually straightening tempered blades, spring leaves, shafts, etc. during the manufacture and to provide a machine for automatically hammering the items into the desired shape.

Another important object of this invention is to provide an automatic straightening machine that receives items on an individual basis, tests each item for straightness, and automatically straightens each item which is distorted.

A more general object of this invention is to increase the rate at which items may be inspected and straightened in a manufacturing facility.

Still another important object of this invention is to provide a machine for automatically inspecting and straightening distorted items, which is suitable to be used in a modern manufacturing facility to perform one of the automatic steps in the production line.

To accomplish these and other objects this invention includes among its many features a frame carrying conveying means which describes a course along which articles to be straightened are directed. A continuously reciprocating hammer is mounted on the frame and is normally disposed in a first position wherein the hammer does not strike the articles moving along the course. The reciprocating hammer is movable to a second position on the frame wherein it can strike the articles. A sensing device is included as part of the assembly and responds to an abnormality in the shape of the article for moving the hammer from the first to the second position.

These and other objects and features of this invention along with its incident advantages will be better understood and appreciated from the following detailed description of one embodiment thereof, selected for purposes of illustration and shown in the accompanying drawing, in which:—

FIG. 1 is an elevation view of a straightening machine constructed in accordance with this invention;

FIGS. 2, 3 and 4 are a series of fragmentary side views illustrating the sequence of steps performed by the machine of FIG. 1 to straighten an article directed through it;

FIG. 5 is a perspective view of a portion of the machine shown in FIG. 1;

FIG. 6 is a perspective view, partly in section, of a portion of the assembly shown in FIG. 5;

FIGS. 6a and 6b are deail view of a part of the assembly shown in FIG. 6; and

FIG. 7 is a schematic diagram of the electro-pneumatic control circuit of the straightening machine.

The machine shown in FIG. 1 includes a frame 10 having an inclined table 12 on which most of the machine parts are mounted. The operative mechanism of the device con-

[*Price 4s. 6d.*]

sists basically of three parts; namely, the conveyor system 14, the hammer assembly 16, and the control circuit.

The conveyor system 14 includes two separated pairs 20 and 22 of spaced rollers 24. The separated pairs of rollers describe a course above the table 12 along which articles to be straightened are directed and in which the hammer assembly 16 performs its function to remove any distortions in the articles being handled. The lower roller of each pair is mounted on the frame 10 a fixed distance above the table 12 while the upper rollers of the pairs are spring loaded as suggested in FIGS. 2—4 to bear down upon the articles as each is fed between the pairs of rollers. As viewed in FIG. 1, the articles being handled by the machine are fed between the rollers from the upper end of the table 12 and are conveyed along the course defined by the rollers toward the lower end.

The pairs of rollers 20 and 22 are driven by a chain and sprocket assembly 26 shown in FIG. 1 connected to the output shaft 27 of a gear reducer 28 in turn driven by a motor 30 through belt and pulley assembly 32. An air clutch 34 is secured to the output shaft 36 of the motor 30 for engaging and disengaging the lower pulley 38 with the shaft 36. A diaphragm-type brake 40 is secured to the input shaft 42 of the gear reducer 28 to prevent drifting of and positively stop the rollers 24.

Just beyond the lower pair 22 of rollers is a contact plate 44 which is insulated from the frame 10 and table 12 by an insulating layer 46. The contact plate 44 is positioned to lie in the path of any article fed between the rollers and along the course described by them, which is not straight. This is suggested in FIGS. 2—4. In FIG. 2 an article 50 is shown being conveyed to the right between the rollers 20 and 22, and the article extends above the plate 44. Because the article 50 is straight it does not engage the contact plate 44. In FIG. 3 an article 50*a* is shown shortly after it has entered between the pairs of rollers 20 and 22, and the leading edge 50*b* of the article is touching the contact plate 44 because the portion of the article between the rollers is distorted. When the portion of the article 50*a* between the pairs of rollers is straightened the article will not again contact the plate 44 until the bend at the trailing end lies between the rollers causing the leading tip 50*b* to drop. It is apparent from an inspection of FIG. 4 that as the article 50*a* is conveyed to the right as viewed in that figure between the rollers 20 and 22, its leading tip 50*b* will again dip downwardly and engage the upper surface of the contact plate 44.

The hammer assembly 16 which hammers the articles into shape is supported above the upper surface of the table 12 by a number of columns 52. The hammer assembly includes a hammer 54 disposed above the rollers midway between the pairs 20 and 22. The hammer 54 is disposed normal to the course described by the pairs of rollers and is oriented to strike articles travelling between the pairs of rollers to the contact plate 44. As the hammer 54 strikes the articles from above, the lower rollers of the pairs serve as anvils for the hammer assembly.

The hammer 54 effectively has two separate inputs; namely, one input which causes the hammer 54 to continuously reciprocate axially toward and away from articles carried by and disposed between the rollers, and another input which causes the hammer while reciprocating, to move downwardly towards the article in the course described by the pairs of rollers. While the hammer 54 continuously reciprocates, the reciprocal stroke of the hammer does not ordinarily carry the impact end 56 to the surface of the article supported on the rollers, but when the hammer is lowered by its second input, the stroke of the hammer is such that its impact end strikes the article supported on the rollers. Both inputs of the hammer 54 employ motor 58 as the power source, which through V-belt assembly 59, turns a drive shaft 60 that carries an eccentric 62. The eccentric 62 carries a block 64 which is slidable laterally in eccentric box 66 closed within a number of plates 68. The box 66 free to move vertically carries a depending collar 70 on its bottom provided with a slot on its inner surface which cooperates with a key 72 on the hammer 54 to prevent the hammer from rotating. The key 72 and the slot limit movement of the hammer 54 relative to the collar 70 and box 62 to an axial direction. The collar 70 at its upper end surrounds an internally threaded gear 74 screwed onto the upper threaded portion 76 of the hammer 54. Thus the gear 74 serves to secure the hammer 54 to the eccentric box 66.

When rotation is imparted to the shaft 60 the eccentric 62 rotates moving the block 64 in a circular path with it. The block 64 is slidable within and movable relative to the box 66 only in a horizontal direction and imparts only vertical reciprocation to the box 66 and the hammer 54 carried by it. The box 66 is constrained to a vertical path by the plates 68 which surround it.

The gear 74 forms part of the second input to the hammer 54 to lower its stroke. The gear 74 which is rotatably mounted within the upper end of the collar 70 is in driving contact with rack 78. The rack extends through the upper portion of the collar 70 and registers with the external teeth of the gear 74. Thus, when the rack moves in one direction and turns the gear 74, the internal threads of that gear act upon the upper

threaded portion 76 of the hammer 54 to lower it relative to the box 66, and when the rack moves in the opposite direction the internal threads on the gear 74 take up the upper threaded portions 76 of the hammer 54 and elevate it relative to the box.

The rack 78 is driven by a gear 80 in turn driven through a pneumatic clutch 82 connected to the output of a ratchet or sprag assembly 84. The input arm 86 of the sprag 84 is connected through a ball and socket joint 88 to the crank arm 90 of an eccentric 92 carried on the end of shaft 60. The sprag 84 in response to rotation of the shaft 60 imparts rotation to the gear 80 in the direction of arrow A. When the gear 80 rotates in the direction of arrow A the rack 78 moves in the direction of arrow B, which lowers the hammer 54 in the collar 70. Thus, the stroke of the hammer 54 is lowered with respect to the box 66 when the rack 78 moves in the direction of arrow B. When the rack is returned to its normal position by being moved in the direction of arrow C, the hammer 54 is elevated in the collar and its stroke is accordingly raised above the feed level defined by the pairs of rollers 20 and 22 on the table 12.

In FIG. 7 the electro-pneumatic control circuit for the straightening machine is illustrated. The circuit includes a sensing electrical circuit 94 and a pneumatic clutch, brake and rack control 96. The sensing circuit 94 is shown connected to a 110 volt line L_1, L_2 through a step down transformer 98. One side of the ouput coil 100 of the transformer is shown grounded at 102, and the other side of the transformer is connected to coil 104 of relay 106, whose other side is connected to the contact plate 44. This end of the sensing circuit 94 is adapted to be connected to ground either by engagement of the contact plate 44 by the article being straightened by the machine as suggested by article 50*a* in FIG. 7 or by closing of the switch 108. The switch 108 forms part of contact breaker 110 that is more fully described in connection with FIGS. 6, 6*a* and 6*b*.

The pneumatic system 96 is connected through solenoid valve 112 to air pressure source 114 utilized to operate the clutches 34 and 82, the brake 40 and air cylinder 116 which serves to move the rack 78 in the direction of arrow C shown in FIG. 5. That is, the air cylinder 116 serves to return the rack 78 to its normal position after it has been displaced from that position by operating the gear 80.

The solenoid valve 112 is designed to alternatively connect the air pressure source 114 to the conduits 118 and 120. The conduit 118 is connected to the clutch 34 and the cylinder 116 while the conduit 120 is connected to the clutch 82 and brake 40. Thus in one condition the solenoid 112 maintains the clutch 34 engaged and the rack 78 withdrawn, and in a second condition the solenoid maintains the clutch 82 engaged and the brake 40 on. The solenoid 112 is energized from the 110 volt source through the switch 122 of relay 106. Because the clutches 34 and 82 are alternately engaged (under no normal operation of the machine are they ever engaged simultaneously), it is seen that when the rollers 24 of the pairs 20 and 22 are driven to convey the article being straightened through the machine, the clutch 82 is engaged so the hammer stroke is lowered to strike the article, the rollers 24 do not rotate to transport the work through the machine and the brake positively locks them in a fixed position. Only after the hammer corrects any abnormality in the article so that it no longer touches the contact plate 44 is the hammer again elevated and the article conveyed through the pairs of rollers of the machine.

As indicated above the circuit for the relay coil 104 may be energized either by connecting the contact plate 44 to ground through the article 50*a* being handled or through the contact breaker 110 which includes switch 108. The contact breaker 110 is provided to maintain the circuit of coil 104 energized during those periods when instantaneous vibration of the article under the blows of a hammer temporarily open the contact between the article and the contact plate 44. Thus, the contact breaker 110 is designed to maintain the coil 104 energized during the portion of each cycle when the hammer strikes the article, and for a short period thereafter to permit the vibrations to dissipate.

The contact breaker 110 is shown in detail in FIGS. 6, 6*a* and 6*b*. In FIG. 6 the hub 130 of extension shaft 132 is shown bolted to the pulley 59*a* of the V-belt drive 59 so that the shaft 132 rotates with the pulley and the drive shaft 60 of the hammer. A bearing assembly 134 is mounted on the inner end of the extension shaft 132 and supports a timing ring 136 which is rotatable with respect to the extension shaft 132 because of the bearing support. The timing ring 136 is releasably locked to a sleeve 138 by means of set screw 140. The sleeve 138 is rigidly secured to the frame 10 of the machine by bracket 142. Thus the sleeve 138 does not rotate with the extension shaft 132, but rather remains fixed, and the shaft 132 rotates within it. The timing ring 136 carries the cam follower 144 with it, which in turn rides on the outer surface of cam 146 keyed to the extension shaft 132. The cam 146 secured to the shaft and rotatably locked to it by key 148 has a dwell 150 provided on its surface which gradually increases in angular span from end 152 to end 154. The cam 146 is urged by means of spring 156 outwardly

on the shaft extension 132, and the knurled nut 158 threaded on the shaft 132 is designed to move the cam 146 against the bias of the spring so that the effective angular span of the dwell may be varied.

The contact breaker assembly shown in FIG. 6 includes two adjustments. First, the span of the dwell may be varied by moving the cam 146 into or out of the timing ring 136 so that the follower 144 rests upon a portion of the cam having a smaller or greater dwell as desired. Second, the period in each cycle during which the dwell is engaged by the follower 144 may be varied by loosening the set screw 140 and moving the timing ring 136 relative to the fixed sleeve 138. Thus, both the duration of the dwell and its period within each cycle may be adjusted. The particular adjustments selected will be determined by the type of material from which the articles being handled are made, their mass, the speed of operation of the machine, etc.

Having described the machine in detail its application will now be described as it may be employed in the straightening of blades, one use specifically contemplated for the machine. During heat treatment blades often distort in an irregular fashion, and it is essential that they may be straightened if they are to be suitable for the use intended. The blades are fed to the machine at the higher end of table 12 and may be directed either manually or automatically to the first pair 20 of rollers. As no contact is made between the blade as it is introduced and the contact plate 44 the circuit for the coil 104 of relay 106 is open and the solenoid valve 112 is denergized. As a result the clutch 34 is engaged and the cylinder 116 retains the rack 78 in its withdrawn position maintaining the hammer stroke above the level of the blade. The motor 58 through the V-belt drive 59 rotates the shaft 60 which causes the hammer 54 to continuously reciprocate. The clutch 82 is disengaged and the brake 40 is released so that the hammer stroke is not lowered, and the motor 30 is free to drive the rollers 24 through the chain and sprocket assembly. If the blade passing through the machine is straight it will not engage the contact plate 44 and consequently the blade will continue through the course described by the pairs of rollers. A microswitch 160 resting on the upper roller 24 of the first pair 20 will sense any abnormal deflection of the roller due to excessive blade thickness or other imperfection in the blade being conveyed by the rollers and can be connected through a circuit (not shown) to shut down the machine.

In the embodiment of the invention illustrated in the drawing, blades may be visually inspected before being introduced between the rollers, and if any curvature is evident the concave side of the blade is faced downwardly toward the table 12. Any blades having a double curvature (those which are S-shaped) should be run through the machine twice, inverting the blade between runs. If the blade being conveyed through the machine by the roller pairs 20 and 22 is downwardly concaved, its leading edge will engage the contact plate 44 in the manner shown in FIG. 3, and the sensing circuit 94 will be grounded by the blade through the frame and the relay coil 104 will become energized. Consequently the relay switch 122 will close, the solenoid 112 will be energized and the air source 114 will be disconnected from the duct 118 and will be connected to the duct 120. Consequently the clutch 34 will be disengaged, the rack 78 will be released by the air cylinder 116, the brake 40 will be applied to stop further rotation of the rollers 24 resulting in the immediate stoppage of the blade in its travel through the rollers, and the clutch 82 will be engaged. Engagement of the clutch 82 will cause the ratchet or sprag assembly 84 to turn the gear 80 through a selected number of degrees during each revolution of the shaft, and the hammer stroke 54 will move downwardly step by step in the direction of the blade captured between the rollers. After one or a few revolutions of the shaft 60, the hammer 54 will strike the blade supported on the lower roller of each pair that serve as anvils. As the hammer 54 strikes the blade being straightened, the cam 146 of the contact breaker will engage the cam follower 144 to provide an alternate energizing circuit for the coil 104 of the relay 106, and this alternate circuit will continue to serve as a substitute for the circuit through the contact plate for a short duration after each blow is struck. Consequently the circuit for the coil 104 is not interrupted and the blade will not be advanced by the rollers before complete correction is made. It may be noted that the relay is damped so that the momentary closing of the circuit by the contact breaker is not sufficient to initially energize the relay, but once energized by the contact plate connection to ground, the contact breaker can maintain the relay energized.

Because the stroke of the hammer 54 is lowered with each revolution of the shaft 60, when the clutch 82 is engaged it will be appreciated that the hammer strikes the blade with increased severity during each revolution of the shaft. The force with which the hammer strikes the work therefore increases continuously until the blade is sufficiently straightened so that its leading end breaks contact with the plate 44. When this occurs the relay is deenergized, the solenoid 112 is deenergized, and once again the compressed air source is connected to duct 118 to withdraw the rack 78. Simultaneously

the clutch 82 is disengaged to allow the rack 78 to be withdrawn without stripping the teeth from the gear 80, and the brake 40 is released to allow the rollers to once again turn and convey the blade. Operation of the rollers continues until the leading edge of the blade once again engages the contact plate 44 as will occur when the blade has the curvature suggested in FIG. 4. When contact is made with the plate 44, the hammer 54 is again lowered, the rollers stop, and successively heavier blows are struck until the blade is again lifted from the contact plate.

While the machine described above is capable of correcting only those blades which are placed in it with the convex side facing upwardly and would require two passes of a blade to remove any double curvature, it will be appreciated that in an alternate embodiment of this invention a machine could employ two hammers and two sensing circuits with contact plates on each side of the course described by the rollers. One hammer would be capable of striking upwardly against the bottom of the blade while the other hammer would strike downwardly as in the embodiment illustrated.

The foregoing description will suggest numerous modifications to those skilled in the art. For example, the actuating mechanism for the hammer 54 may be changed as can be electro-penumatic control circuit. Therefore, it is not intended that the scope of this invention be limited to the single embodiment illustrated and described. Rather, it is intended that the scope of this invention be determined by the appended claims.

WHAT I CLAIM IS:—

1. A straightening machine comprising a continuously reciprocable hammer moveable between a first position in which the hammer cannot strike a workpiece located in a workpiece receiving station and a second position in which the hammer can strike the workpiece while at the station, and sensing means responsive to deviations from a desired shape of a workpiece adapted to control the movement of the hammer from one position to the other.

2. A machine as claimed in claim 1, and further comprising conveyor means for transporting workpieces to the workpiece receiving station.

3. A machine as claimed in claim 2, wherein the conveyor means is adapted to provide an anvil for supporting the workpiece whilst at the receiving station.

4. A machine as claimed in claim 2 or 3, wherein said conveyor means is adapted to define a prescribed course along which workpieces to be straightened are directed through the workpiece receiving station.

5. A machine as claimed in claim 4, wherein means are provided for stopping the conveyor means while the hammer is moving from the first to the second hammer position, the arrangement being such that the strokes of the hammer penetrate said course with increased depth with each reciprocation thereof.

6. A machine as claimed in claim 5, and comprising a first drive for moving the hammer from the first position to the second position, a first clutch in the first drive, a second drive for operating the conveyor means, a second clutch in the second drive, and means controlled by the sensing means for maintaining, whilst the hammer is in the second position, the first clutch engaged and the second clutch disengaged.

7. A machine as claimed in claim 6, wherein a brake unit is provided for locking the conveyor means against movement when the second clutch is in its disengaged position.

8. A machine as claimed in claim 6 or 7, wherein the first drive includes an eccentric block arrangement the hammer being connected to the block arrangement through an adjustable coupling which permits the effective length of the hammer to be selectively varied, and wherein the means for moving the hammer is adapted to adjust said coupling in such manner as to vary said length.

9. A machine as claimed in any of claims 4 to 8, and further comprising means controlled by the sensing means for returning the hammer from the second position to the first position whenever the sensing means detects that the workpiece is confined to the prescribed course.

10. A machine as claimed in any of claims 4 to 9, wherein the sensing means includes an electrical circuit having a contact plate disposed adjacent said course and in the path of the workpieces when they stray to one side of the said course.

11. A machine as claimed in claim 10, and wherein means forming part of the sensing means are provided for closing said circuit during momentary relative displacements between the workpieces and the plate due to vibrations produced by the impact between the hammer and the workpieces.

12. A machine as claimed in any of claims 4 to 11, wherein the conveyor means includes pairs of spaced rollers the rollers of each pair being spaced a distance substantially equal to the thickness of the workpieces to be handled by the machine, and wherein the hammer is so positioned relative to said pairs that it strikes the workpieces between the separated pairs of rollers.

13. A machine as claimed in claim 12, wherein means are provided for detecting any abnormal movement of one of rollers of the first pair, and wherein the detection means

is adapted on detection of an excessive deflection to stop the operation of the machine.

14. A machine, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1046297 COMPLETE SPECIFICATION

3 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

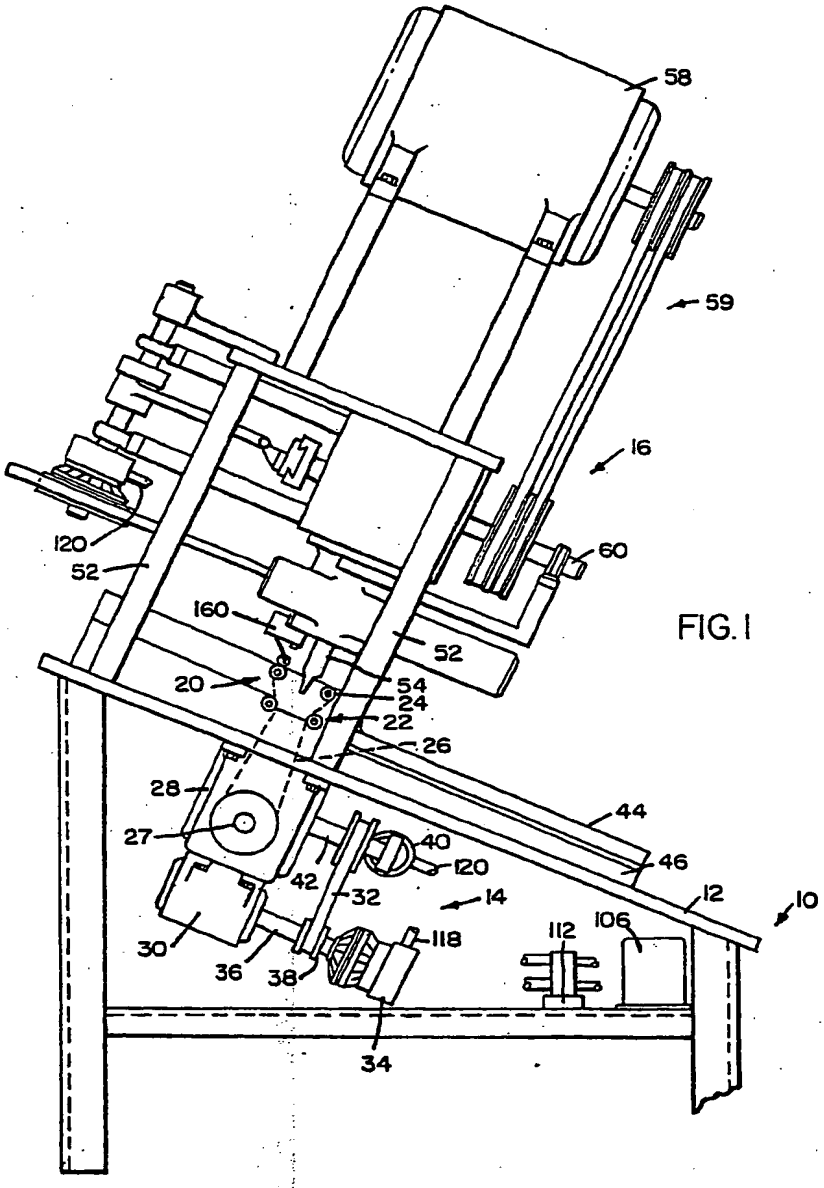

FIG. 1

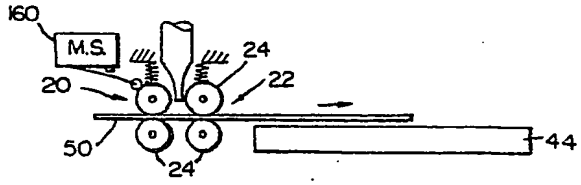

FIG. 2

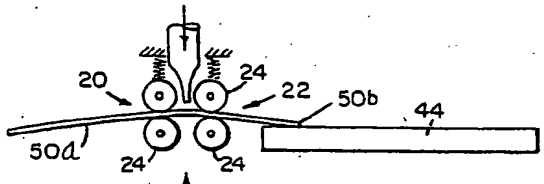

FIG. 3

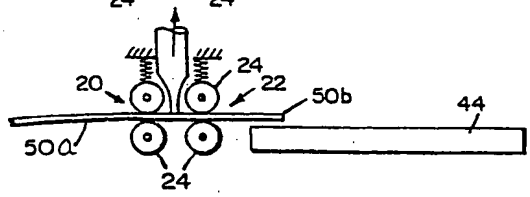

FIG. 4

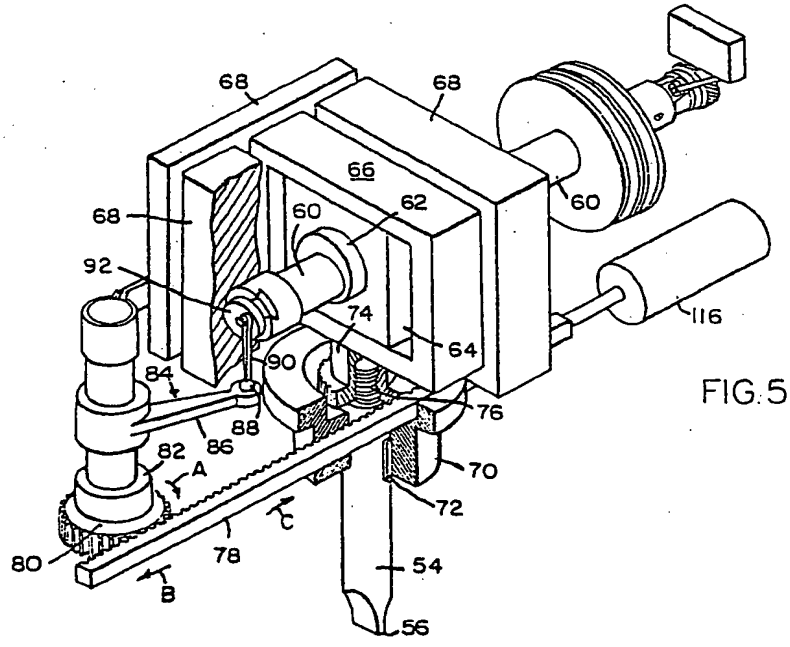

FIG. 5

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FIG. 2

G. 3

IG. 4

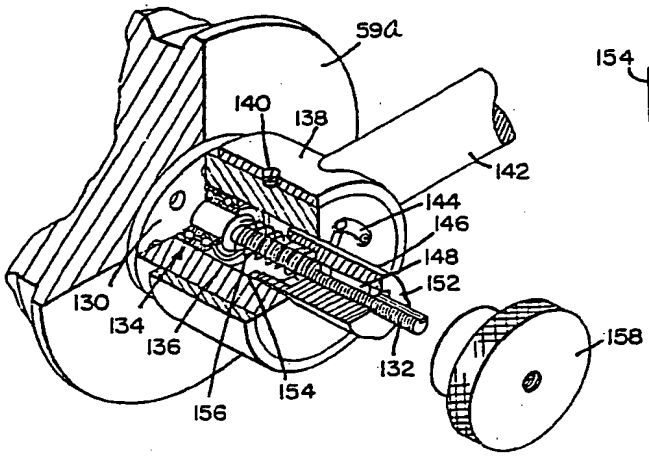

FIG. 6

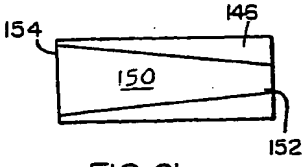

FIG. 6b

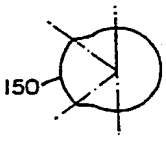

FIG. 6a

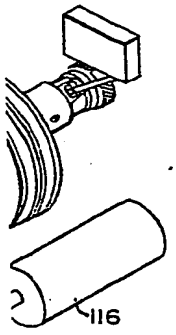

FIG. 5

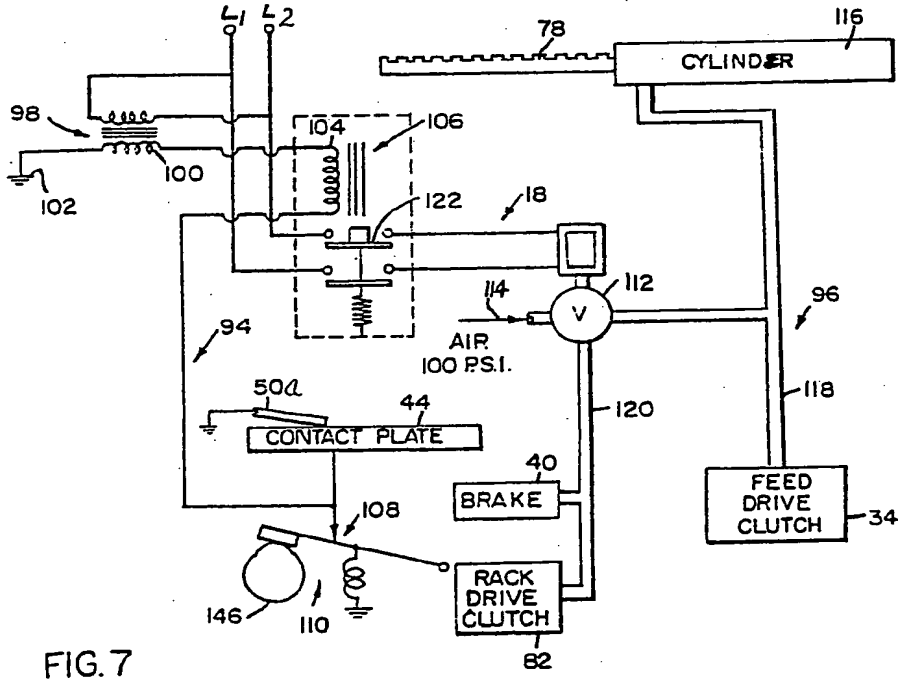

FIG. 7

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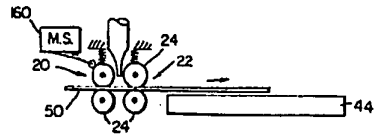

FIG. 2

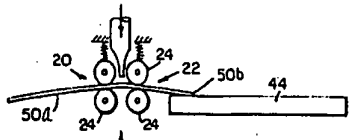

FIG. 3

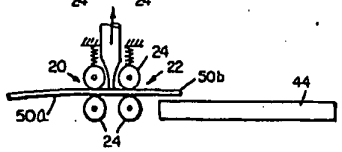

FIG. 4

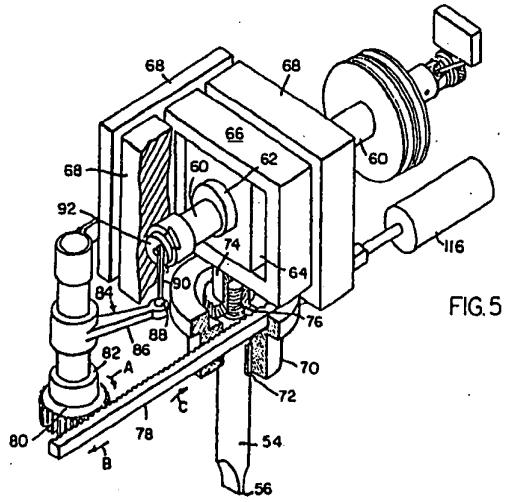

FIG. 5

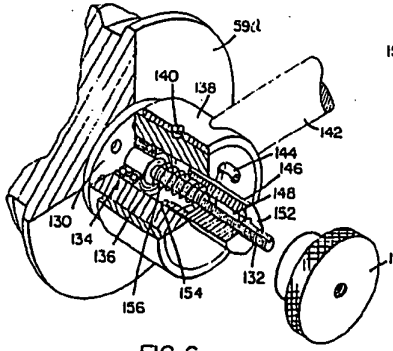

FIG. 6

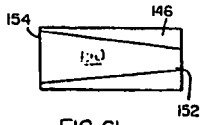

FIG. 6b

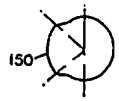

FIG. 6a

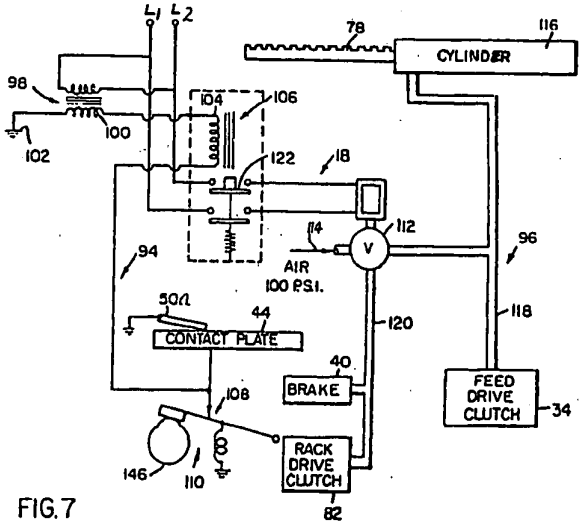

FIG. 7